Appendixes

Appendix A

Evaluating CBO's Record of Economic Forecasts

Since publishing its first forecast in 1976, the Congressional Budget Office has compiled a record of economic predictions that compares favorably with the track records of four Administrations as well as with the consensus forecasts of a sizable sample of economic forecasters. Although the margin is slight, CBO's forecasts have generally been closer than the Administration's to the actual values of several economic indicators that are important for projecting the budget. Moreover, during the 10 years for which comparisons are possible, CBO's forecasts have been about as accurate as the average of the 50 or so private-sector forecasts that constitute the *Blue Chip* consensus survey. Comparing CBO's forecasts with this survey suggests that, although CBO's economic predictions have sometimes missed the mark by margins large enough to contribute to sizable misestimates of the deficit, these errors probably reflect limitations that confront all forecasters.

These conclusions echo the findings of previous studies published by CBO and other government and academic reviewers. They emerge from an evaluation of the accuracy of short-term forecasts of growth in real gross national product (GNP), inflation in the consumer price index (CPI), and measures of the interest rate on three-month Treasury bills, both in nominal and inflation-adjusted (real) terms. In this evaluation, CBO has compiled two-year averages of its forecasts for these indicators and compared them with the historical values as well as with the corresponding forecasts of the Administration and the *Blue Chip* consensus.

A comparison of forecasts issued early in each calendar year from 1976 through 1991 indicates that both CBO and the Administration have tended to err toward optimism in their forecasts for a two-year horizon--that is, the average forecast error exceeded zero for real growth and was less than zero for interest rates and inflation. On average, the errors in the Administration's forecasts were slightly larger than in CBO's. Moreover, an examination of longer-term projections of growth of real GNP reaches similar conclusions: CBO's errors in projecting four-year average growth of real GNP were optimistic on average and smaller than the Administration's. Finally, CBO's forecasts appear to be about as accurate as the average of the *Blue Chip* forecasters over the period for which comparable *Blue Chip* forecasts are available (1982-1991).

Note, however, that the differences between the three forecasts are too small to be statistically significant. The small number of forecasts available for the analysis makes it difficult to distinguish meaningful differences in forecast performance from those differences that might arise randomly. As a result, the statistics presented here are not reliable indicators of the future performance of any of the three forecasters.

Data Sources

This section describes the sources used and calculations made in compiling the basic historical and forecast data for growth in real GNP, CPI inflation, and short-term interest rates. Although each of these series has an important influence on budget projections, an accurate forecast of the two-year average growth of real GNP is the most critical

economic factor in accurately estimating the deficit for the upcoming budget year. Two-year average forecasts published in early 1992 and 1993 could not be included because historical values for 1993 and 1994 are not yet available.[1] The data were therefore compiled for the years 1976 through 1991.

Selection of Historical Data

The choice of historical data was dictated by the nature of the individual forecasts examined. For CPI inflation and short-term interest rates, this choice was clear-cut. Choosing a series for real economic growth was less so.

CPI Inflation. Two-year averages of CPI inflation were calculated from calendar year averages of monthly data published by the Bureau of Labor Statistics. For all of the years examined here, the Administration published its forecasts for the CPI-W (the price index for urban wage earners and clerical workers), the measure used to index federal entitlement programs. By contrast, for all but four of its forecasts (1986 through 1989), CBO based its inflation forecast on the CPI-U (the price index for all urban consumers), a more widely cited measure of inflation and the one now used to index federal income tax brackets. Although annual fluctuations in the CPI-U and CPI-W are virtually indistinguishable in most years, they differ in some years; therefore, historical data for both series were used to evaluate the alternative forecast records.

Short-Term Interest Rates. Two-year averages of nominal short-term interest rates were similarly developed from calendar year averages of monthly data published by the Board of Governors of the Federal Reserve System. Historical values for the interest rate on three-month Treasury bills were used in evaluating the forecasts. Separate historical values for real interest rates were calculated using the inflation rate appropriate for each forecaster. In each case, the two-year average nominal interest rate was discounted by the two-year average rate of inflation. The resulting real short-term interest rates were very similar to each other.

Real GNP Growth. The selection of historical values for growth of real GNP was complicated not by differences in the measure the individual forecasters predicted through the years--CBO, the Administration, and the *Blue Chip* consensus all published forecasts of the same measure--but by the periodic benchmark revisions of the historical values themselves. For example, during the 1976-1985 period, the forecasters published estimates for a measure of growth in real GNP that was based on 1972 prices. In late 1985, however, the Bureau of Economic Analysis (BEA) discontinued this 1972-dollar series and began to publish GNP on a 1982-dollar basis. As a result, an official series of values for GNP growth in 1972 dollars is not available for years after 1984. BEA revised the benchmark again in the second half of 1991; it discontinued 1982-dollar GNP and began to publish GNP on a 1987-dollar basis. Consequently, the historical annual series for 1982-dollar GNP is available only through 1990.

By updating the series to reflect more recent prices, BEA's benchmark revisions yield a measure of real GNP that is more relevant for analyzing contemporary movements in real growth. But the process makes it difficult to evaluate forecasts of real growth produced over a period of years for series that are subsequently discontinued. Recently, however, the difficulties presented by periodic revisions of the data have been diminished by the availability of a new measure of real growth. In 1992, BEA began to publish and regularly update an alternative series for real GNP that

1. In early 1992, CBO began to publish forecasts and projections of gross domestic product rather than GNP. This switch will not be reflected in the evaluation of CBO's forecast until data for 1993 are available. In addition, the Clinton Administration adopted CBO's economic assumptions as the basis for its budget in early 1993. As a result, once the 1993 data are available, the errors for that early 1993 forecast will be virtually the same for CBO and the Administration.

essentially merges the various base years.[2] CBO used that measure--the benchmark-years-weighted index of real GNP--to evaluate the forecasts.[3]

Sources for Forecast Data

The evaluation used calendar year forecasts and projections, which CBO has published early each year since 1976, timed so as to coincide with the publication of the Administration's budget proposals. The Administration's forecasts were taken from the Administration's budget in all but one case: the forecast made in early 1981 was taken from the new Reagan Administration's revisions to President Carter's last budget. The corresponding CBO forecast was taken from a projection published in its analysis of the Reagan budget proposals. That forecast did not include the economic effects of the new Administration's fiscal policy proposals.

The average forecasts of the *Blue Chip* consensus survey were taken from those published in the same month as CBO's forecasts. Because the *Blue Chip* consensus did not begin publishing its two-year forecasts until the middle of 1981, the first consensus forecasts available for use in this analysis were published in early 1982.

Measuring Bias and Accuracy

Following earlier studies of economic forecasts, this evaluation of CBO's forecasts focuses on two aspects of forecast performance: statistical bias and accuracy.

The statistical bias of a forecast is the extent to which a forecast can be expected to differ from what actually occurs. This evaluation uses the *mean error* to measure statistical bias. This statistic--the average of all the forecast errors--is the simplest and most widely used measure of forecast bias. In calculating the mean error, underestimates and overestimates will offset each other. As a result, the mean error imperfectly measures the quality of a forecast--a small mean error would result if all the errors were small or if all the errors were large but the overestimates and underestimates happened to offset each other.

The accuracy of a forecast is the degree to which forecast values are dispersed around actual outcomes. Measures of accuracy more clearly reflect the usual meaning of forecast performance than does the mean error. This evaluation uses two measures of accuracy. The *mean absolute error*--the average of the forecast errors without regard to arithmetic sign--indicates the average distance between forecasts and actual values without regard to whether individual forecasts are overestimates or underestimates. The *root mean square error*--calculated by first taking the square of all errors, then taking the square root of the average of the squared errors--also shows the size of the error without regard to sign, but it gives greater weight to larger errors.

These three statistics do not exhaust the available supply of measures of forecast performance. For example, to test for statistical bias in CBO's forecasts, previous studies have used measures that are slightly more elaborate than the mean error. Those studies have generally concluded, as does this evaluation,

2. For details on the conceptual basis and empirical characteristics of this new series, see A. H. Young, "Alternative Measures of Change in Real Output and Prices," *Survey of Current Business* (April 1992), pp. 32-48; J. E. Triplett, "Economic Theory and BEA's Alternative Quantity and Price Indexes," *Survey of Current Business* (April 1992), pp. 49-52; and A. H. Young, "Alternative Measures of Change in Real Output and Prices: Quarterly Estimates for 1959-92," *Survey of Current Business* (March 1993), pp. 31-41.

3. Alternative approaches to updating the 1972-dollar and 1982-dollar series did not substantially affect the evaluation of the forecasts. These alternatives included an extension of the 1982-dollar series using a 57-component disaggregation of GNP, a method used in other forecast evaluations. See, for example, S. K. McNees, "How Accurate Are Macroeconomic Forecasts?" *New England Economic Review* (July/August 1988), pp. 15-36.

that the bias in CBO's short-term economic forecasts is not statistically significant.[4] Also, a number of methods have been developed to evaluate a forecast's efficiency. Forecast efficiency indicates the extent to which a particular forecast could have been improved by using additional information at the forecaster's disposal at the time the forecast was made.[5] The use of the *Blue Chip* consensus in this evaluation can be interpreted as a proxy for an efficient forecast; that CBO's forecasts are about as accurate as the *Blue Chip* is an approximate indication of forecast efficiency.

These more elaborate measures are not necessarily reliable indicators when the sample of observations is small, such as the 16 observations that make up the sample of CBO's two-year forecasts. Small samples present three broad types of difficulties for evaluations of forecasts, including those based on the simple measures presented here. First, small samples reduce the reliability of statistical tests that are based on the assumption that the underlying population follows a normal distribution. The more elaborate tests of forecast performance are all based on such an assumption concerning the hypothetical ideal forecast with which the actual forecasts are compared. Second, in small samples, a relatively large weight is assigned to individual forecast errors in the calculation of summary measures. The mean error, for example, can fluctuate in arithmetic sign when additional observations are added to a small sample. Finally, the small sample means that CBO's forecast history cannot be used in a statistically reliable way to indicate either the direction or the size of future estimating errors.

Apart from the general caution that should attend statistical conclusions based on small samples, there are several other reasons to view this evaluation of CBO's forecasts with particular caution. First, the procedures and purposes of CBO's and the Administration's forecasts have changed over the past 17 years and may change in the future. For example, in the late 1970s, CBO characterized its long-term projection as a goal for the economy, whereas CBO now considers it a projection that will prevail on average if the economy continues to reflect historical trends. Second, an institution's ability to forecast may change over time because of changes in personnel and methods. Finally, forecast errors increase when the economy is more volatile. When the economy undergoes a recession, the errors of all three forecasters tend to be larger than the average of the 16 forecasts examined here.

CBO's Forecast Record

CBO's forecasts have been evaluated over two-year and four-year periods. The period of most interest for forecasters of the budget is two years. Because the central focus of the Administration's and CBO's winter publications is the budget projection for the fiscal year beginning in October of that year, an economic forecast that is accurate not only for the months leading up to the budget year but also for the months of the budget year itself will provide the basis for a more accurate forecast of the deficit. A four-year horizon is used to examine

4. Another approach to testing a forecast for bias is based on linear regression analysis of actual and forecast values. For details on this method, see J. Mincer and V. Zarnowitz, "The Evaluation of Economic Forecasts," in J. Mincer, ed., *Economic Forecasts and Expectations* (New York: National Bureau of Economic Research, 1969). This approach is not used here because of the small sample size. However, previous studies that have used this method to evaluate the short-term forecasts of CBO and the Administration have not been able to reject the hypothesis that those forecasts are unbiased. See, for example, M. T. Belongia, "Are Economic Forecasts by Government Agencies Biased? Accurate?" *Review*, Federal Reserve Bank of St. Louis, vol. 70, no. 6 (November/December 1988), pp. 15-23.

5. For studies that have examined the relative efficiency of CBO's forecasts, see Belongia, "Are Economic Forecasts by Government Agencies Biased? Accurate?"; and S. M. Miller, "Forecasting Federal Budget Deficits: How Reliable Are U.S. Congressional Budget Office Projections?" *Applied Economics*, vol. 23 (December 1991), pp. 1789-1799. Although both of these studies identify series that might have been used to make CBO's forecasts more accurate, they rely on statistics that assume a larger sample than is available. Moreover, although statistical tests can identify sources of inefficiency in a forecast after the fact, these tests generally do not indicate how such inefficiencies may be used to improve forecasts at the time they are made.

the accuracy of longer-term projections of real GNP growth.

Short-Term Forecasts

CBO's two-year forecasts have been slightly more accurate overall and suffer from slightly less statistical bias than the Administration's. In most cases, however, the differences are slim. Furthermore, CBO's forecast is about as accurate as the *Blue Chip* average forecast.

An accurate forecast for two-year growth of real GNP is the most important factor in minimizing errors in forecasting the deficit for the budget year. Accurate forecasts of inflation, nominal GNP growth, and nominal interest rates are less important for forecasting deficits now than they were in the late 1970s and early 1980s. The reason is that, given current law and the level of the national debt, inflation increases both revenues and outlays by similar amounts. Revenues increase with inflation because taxes are levied on nominal incomes. Outlays increase because various entitlement programs are indexed to inflation and because nominal interest rates tend to increase with inflation, which in turn increases the cost of servicing the federal debt.[6]

Real GNP Growth. For the two-year forecasts made between 1976 and 1991, CBO had a slightly better record than the Administration in forecasting real GNP growth (see Table A-1). Both CBO and the Administration tended to overestimate growth of real GNP on average. For the 16 forecasts made during the 1976-1991 period, the average errors were 0.5 percentage points for CBO and 0.7 percentage points for the Administration. The root mean square errors for this period were 1.1 percentage points for CBO and 1.4 percentage points for the Administration. For the 10 forecasts made in 1982 through 1991, CBO's forecasts of two-year growth of real GNP were as accurate as the *Blue Chip* average.

Forecast errors tend to grow larger when the economy is more unstable. This tendency can be clearly seen in the forecasts of growth of real GNP by comparing the large errors for the years from 1979 through 1983--when the economy went through its most turbulent recessionary period of the postwar era--with the smaller errors recorded for later years. Similarly, the recent business cycle accounts for the large errors in the forecasts made in 1989 through 1991; during this period, CBO's errors were only slightly larger than those of the *Blue Chip*.

CPI Inflation. The records for forecasting the average annual growth of the consumer price index over the two-year horizon are very similar (see Table A-2). Both CBO and the Administration underestimated future inflation in their forecasts for 1977 through 1980, and both tended to overestimate inflation in their forecasts for 1981 through 1986. The average measures of bias and accuracy are virtually the same for CBO and the Administration. CBO was closer to the true value in 6 of the 16 periods, the Administration was closer in 7 periods, and the two forecasters had identical errors in 3 periods.

For the 1982-1991 forecasts, CBO's inflation forecasts appear to be slightly more accurate than those of both the Administration and the *Blue Chip* consensus.

Nominal Short-Term Interest Rates. For the 1976-1991 forecasts, CBO's record is slightly more accurate than the Administration's for nominal short-term interest rates over the two-year horizon (see Table A-3). On average, both forecasters underestimated interest rates, although CBO's mean error was smaller than the Administration's. For the 1982-1991 period, the mean absolute error of CBO's forecasts is only slightly above those of the Administration and the *Blue Chip*.

Real Short-Term Interest Rates. For the forecasts made in 1976 through 1991, CBO

6. **Rules of thumb for estimating the effect on the deficit of** changes in various macroeconomic variables are given in Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1994-1998* (January 1993), pp. 109-113.

had a slight edge over the Administration in estimating short-term interest rates adjusted for inflation (see Table A-4). Both CBO and the Administration had an optimistic bias; that is, they forecast lower interest rates, adjusted for inflation, than actually occurred on average, but the Administration's bias was greater. The Administration's mean absolute and root mean square errors were also larger. CBO's forecast was closer to the actual value in 9 of the 16 periods; the Administration's was closer in only 6.

For forecasts made between 1982 and 1991, CBO's errors are generally similar in both direction and magnitude to those of the *Blue Chip* consensus.

Longer-Term Projections

The Administration's errors for real GNP growth for the more distant future, measured here as four years ahead, were larger than CBO's. Although this comparative advantage for CBO does not directly affect the estimates of the deficit for the budget year, accuracy in the longer term is obviously important for budgetary planning over several years. Neither the Administration nor CBO, however, considers its projections to be its best guess about the year-to-year course of the economy. The Administration indicates that its projection is based on the adoption of the President's budget, and in recent years, CBO has considered its projections an indication of the average future performance of the economy if major historical trends prevail. Neither forecaster attempts to anticipate cyclical fluctuations in the projection period.

CBO's projections of medium-term growth in real GNP for 1976 through 1989 were nearly always closer to actual growth than were the Administration's. The Administration's projections showed an upward bias of 1.3 percentage points for the average annual rate of real GNP growth over four-year periods, compared with an upward bias of 0.9 percentage points for CBO's (see Table A-5). These biases resulted largely from the inability of the projections made in early 1977 through 1980 to anticipate the recessions of 1980 and 1982. Through the subsequent years of expansion until the most recent recession, the upward bias was much smaller for the Administration's projections and smaller yet for CBO's.

The size of the root mean square errors for the entire period for both CBO and, to a lesser extent, the Administration is also largely the result of errors in projections made during the first five years. CBO had a definite edge in the projections made in January 1981 and 1982 and a lesser edge in later years. CBO's projection of four-year real GNP growth was more accurate than the Administration's for 13 of the 14 periods compared here.

Table A-1.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of the Two-Year Average Growth Rate of Real GNP (By calendar year, errors in percentage points)

	Actual									
	1972 Dollars	1982 Dollars	1987 Dollars	Benchmark-Years-Weighted Index	CBO		Administration		*Blue Chip*	
					Forecast	Error	Forecast	Error	Forecast	Error
1976-1977	6.7	4.8	4.8	5.5	6.2	0.7	5.9	0.5	a	a
1977-1978	5.2	5.0	4.7	5.2	5.5	0.3	5.1	0	a	a
1978-1979	3.9	3.9	3.8	4.1	4.7	0.6	4.7	0.6	a	a
1979-1980	1.3	1.1	1.1	1.5	2.7	1.2	2.9	1.4	a	a
1980-1981	1.1	0.9	0.5	1.2	0.5	-0.7	0.5	-0.7	a	a
1981-1982	0.2	-0.3	-0.4	0.2	2.1	1.9	2.6	2.4	a	a
1982-1983	0.7	0.5	0.7	0.9	2.1	1.3	2.7	1.8	2.0	1.2
1983-1984	5.2	5.2	4.9	5.1	3.4	-1.7	2.6	-2.5	3.5	-1.6
1984-1985	b	5.1	4.4	4.7	4.7	0	4.7	0	4.3	-0.4
1985-1986	b	3.0	2.8	2.8	3.3	0.5	3.9	1.1	3.2	0.3
1986-1987	b	3.1	2.9	2.9	3.1	0.3	3.7	0.8	3.0	0.1
1987-1988	b	3.9	3.5	3.5	2.9	-0.6	3.3	-0.2	2.8	-0.7
1988-1989	b	3.5	3.3	3.3	2.4	-0.8	3.0	-0.3	2.1	-1.1
1989-1990	b	1.7	1.8	1.7	2.5	0.8	3.2	1.5	2.2	0.5
1990-1991	b	c	-0.2	-0.2	2.0	2.2	2.8	3.0	1.9	2.1
1991-1992	b	c	0.4	0.3	1.6	1.3	1.4	1.0	1.2	0.9
Statistics for 1976-1991										
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	0.5	n.a.	0.7	n.a.	n.a.
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	0.9	n.a.	1.1	n.a.	n.a.
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.1	n.a.	1.4	n.a.	n.a.
Statistics for 1982-1991										
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	0.3	n.a.	0.6	n.a.	0.1
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	0.9	n.a.	1.2	n.a.	0.9
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.1	n.a.	1.5	n.a.	1.1

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Department of Commerce, Bureau of Economic Analysis.

NOTES: Actual values are the two-year growth rates for real gross national product (GNP) last reported by the Bureau of Economic Analysis, not the first reported values. Forecast values are for the average annual growth of real GNP over the two-year period. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate. The benchmark-years-weighted index of actual GNP was used in calculating the errors.

n.a. = not applicable.

a. Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

b. Data for 1972-dollar GNP are available only through the third quarter of 1985.

c. Data for 1982-dollar GNP are available only through the third quarter of 1991.

Table A-2.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of the Two-Year Average Inflation Rate in the Consumer Price Index (By calendar year, errors in percentage points)

	Actual		CBO		Administration		*Blue Chip*	
	CPI-U	CPI-W	Forecast	Error	Forecast	Error	Forecast	Error
1976-1977	6.1	6.1	7.1	1.0	6.1	0	a	a
1977-1978	7.0	7.0	4.9	-2.1	5.2	-1.8	a	a
1978-1979	9.4	9.5	5.8	-3.6	6.0	-3.5	a	a
1979-1980	12.4	12.5	8.1	-4.3	7.4	-5.0	a	a
1980-1981	11.9	11.9	10.1	-1.8	10.5	-1.4	a	a
1981-1982	8.2	8.1	10.4	2.1	9.7	1.6	a	a
1982-1983	4.6	4.5	7.2	2.6	6.6	2.1	7.2	2.6
1983-1984	3.8	3.3	4.7	1.0	4.7	1.5	4.9	1.1
1984-1985	3.9	3.5	4.9	1.0	4.5	1.0	5.2	1.3
1985-1986	2.7	2.5	4.1	1.4	4.2	1.7	4.3	1.6
1986-1987	2.8	2.6	3.8	1.2	3.8	1.2	3.8	1.0
1987-1988	3.9	3.8	3.9	0.1	3.3	-0.5	3.6	-0.2
1988-1989	4.4	4.4	4.7	0.3	4.2	-0.2	4.3	-0.1
1989-1990	5.1	5.0	4.9	-0.1	3.7	-1.3	4.7	-0.4
1990-1991	4.8	4.6	4.1	-0.7	3.9	-0.7	4.1	-0.7
1991-1992	3.6	3.5	4.2	0.6	4.6	1.1	4.4	0.8
Statistics for 1976-1991								
Mean error	n.a.	n.a.	n.a.	-0.1	n.a.	-0.2	n.a.	n.a.
Mean absolute error	n.a.	n.a.	n.a.	1.5	n.a.	1.5	n.a.	n.a.
Root mean square error	n.a.	n.a.	n.a.	1.9	n.a.	1.9	n.a.	n.a.
Statistics for 1982-1991								
Mean error	n.a.	n.a.	n.a.	0.7	n.a.	0.6	n.a.	0.7
Mean absolute error	n.a.	n.a.	n.a.	0.9	n.a.	1.1	n.a.	1.0
Root mean square error	n.a.	n.a.	n.a.	1.1	n.a.	1.3	n.a.	1.2

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Department of Labor, Bureau of Labor Statistics.

NOTES: Values are for the average annual growth of the consumer price index (CPI) over the two-year period. For most years, CBO forecast the CPI-U (for all urban consumers); from 1986 through 1989, CBO forecast the CPI-W (for urban wage earners and clerical workers). The Administration forecast the CPI-W, and the *Blue Chip* consensus forecast the CPI-U. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate.

n.a. = not applicable.

a. Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

Table A-3.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of the Two-Year Average Interest Rate on Three-Month Treasury Bills (By calendar year, errors in percentage points)

		CBO		Administration		*Blue Chip*	
	Actual	Forecast	Error	Forecast	Error	Forecast	Error
1976-1977	5.1	6.2	1.1	5.5	0.4	a	a
1977-1978	6.2	6.4	0.2	4.4	-1.8	a	a
1978-1979	8.6	6.0	-2.6	6.1	-2.5	a	a
1979-1980	10.8	8.3	-2.5	8.2	-2.6	a	a
1980-1981	12.8	9.5	-3.3	9.7	-3.1	a	a
1981-1982	12.4	13.2	0.9	10.0	-2.4	a	a
1982-1983	9.7	12.6	2.9	11.1	1.4	11.3	1.6
1983-1984	9.1	7.1	-2.0	7.9	-1.1	7.9	-1.2
1984-1985	8.5	8.7	0.2	8.1	-0.4	9.1	0.5
1985-1986	6.7	8.5	1.8	8.0	1.3	8.5	1.8
1986-1987	5.9	6.7	0.9	6.9	1.0	7.1	1.2
1987-1988	6.2	5.6	-0.6	5.5	-0.7	5.7	-0.5
1988-1989	7.4	6.4	-0.9	5.2	-2.1	6.1	-1.2
1989-1990	7.8	7.5	-0.3	5.9	-1.9	7.5	-0.3
1990-1991	6.5	7.0	0.6	6.0	-0.4	7.1	0.7
1991-1992	4.4	6.8	2.4	6.2	1.8	6.4	2.0
Statistics for 1976-1991							
Mean error	n.a.	n.a.	-0.1	n.a.	-0.8	n.a.	n.a.
Mean absolute error	n.a.	n.a.	1.4	n.a.	1.6	n.a.	n.a.
Root mean square error	n.a.	n.a.	1.8	n.a.	1.8	n.a.	n.a.
Statistics for 1982-1991							
Mean error	n.a.	n.a.	0.5	n.a.	-0.1	n.a.	0.5
Mean absolute error	n.a.	n.a.	1.3	n.a.	1.2	n.a.	1.1
Root mean square error	n.a.	n.a.	1.5	n.a.	1.4	n.a.	1.2

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Federal Reserve Board.

NOTES: Values are for the geometric average of the three-month Treasury bill rate for the two-year period. The actual values are published by the Federal Reserve Board as the rate on new issues, reported on a bank-discount basis. Although the *Blue Chip* consensus reports estimates of the secondary market rate (not the new issue rate), the historical differences between the two rates are minuscule. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate.

n.a. = not applicable.

a. Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

Table A-4.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of the Two-Year Average Interest Rate on Three-Month Treasury Bills Adjusted for Inflation (By calendar year, errors in percentage points)

	Actual		CBO		Administration		*Blue Chip*	
	Based on CPI-U	Based on CPI-W	Forecast	Error	Forecast	Error	Forecast	Error
1976-1977	-0.9	-0.9	-0.8	0.1	-0.6	0.3	a	a
1977-1978	-0.8	-0.7	1.5	2.2	-0.8	-0.1	a	a
1978-1979	-0.7	-0.8	0.2	0.9	0.1	0.9	a	a
1979-1980	-1.4	-1.5	0.2	1.6	0.7	2.2	a	a
1980-1981	0.8	0.9	-0.5	-1.4	-0.7	-1.6	a	a
1981-1982	3.8	4.0	2.6	-1.2	0.3	-3.7	a	a
1982-1983	4.8	4.9	5.0	0.2	4.2	-0.8	3.8	-1.0
1983-1984	5.1	5.7	2.2	-2.9	3.1	-2.6	2.9	-2.3
1984-1985	4.4	4.9	3.6	-0.8	3.4	-1.4	3.6	-0.8
1985-1986	3.9	4.1	4.2	0.3	3.6	-0.4	4.0	0.1
1986-1987	3.0	3.2	2.8	-0.4	3.0	-0.3	3.2	0.2
1987-1988	2.3	2.4	1.7	-0.7	2.1	-0.2	2.0	-0.3
1988-1989	2.8	2.9	1.7	-1.2	1.0	-1.9	1.8	-1.0
1989-1990	2.6	2.6	2.5	-0.2	2.1	-0.6	2.7	0.1
1990-1991	1.6	1.7	2.8	1.2	2.0	0.3	2.9	1.3
1991-1992	0.8	0.9	2.5	1.7	1.5	0.6	1.9	1.1
Statistics for 1976-1991								
Mean error	n.a.	n.a.	n.a.	0	n.a.	-0.6	n.a.	n.a.
Mean absolute error	n.a.	n.a.	n.a.	1.1	n.a.	1.1	n.a.	n.a.
Root mean square error	n.a.	n.a.	n.a.	1.3	n.a.	1.5	n.a.	n.a.
Statistics for 1982-1991								
Mean error	n.a.	n.a.	n.a.	-0.3	n.a.	-0.7	n.a.	-0.2
Mean absolute error	n.a.	n.a.	n.a.	1.0	n.a.	0.9	n.a.	0.8
Root mean square error	n.a.	n.a.	n.a.	1.3	n.a.	1.2	n.a.	1.0

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Department of Labor, Bureau of Labor Statistics; Federal Reserve Board.

NOTES: Values are for the three-month Treasury bill rate discounted by the respective forecast for inflation as measured by the change in the consumer price index (CPI). For most years, CBO forecast the CPI-U (for all urban consumers); from 1986 through 1989, CBO forecast the CPI-W (for urban wage earners and clerical workers). The Administration forecast the CPI-W, and the *Blue Chip* consensus forecast the CPI-U. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate.

n.a. = not applicable.

a. Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

Table A-5.
Comparison of CBO and Administration Forecasts of the Four-Year Average Growth Rate of Real GNP (By calendar year, errors in percentage points)

	Actual							
	1972 Dollars	1982 Dollars	1987 Dollars	Benchmark-Years-Weighted Index	CBO		Administration	
					Forecast	Error	Forecast	Error
1976-1979	5.3	4.3	4.3	4.8	5.9	1.1	6.1	1.3
1977-1980	3.2	3.0	2.9	3.3	5.4	2.1	5.4	2.1
1978-1981	2.5	2.4	2.1	2.7	4.8	2.1	4.8	2.2
1979-1982	0.7	0.4	0.4	0.9	3.6	2.7	3.7	2.8
1980-1983	0.9	0.7	0.6	1.0	2.1	1.0	2.6	1.5
1981-1984	2.7	2.4	2.2	2.6	2.6	0	3.7	1.0
1982-1985	a	2.7	2.5	2.8	2.8	0.1	3.8	1.0
1983-1986	a	4.1	3.8	4.0	3.6	-0.3	3.3	-0.7
1984-1987	a	4.1	3.6	3.8	4.1	0.3	4.3	0.6
1985-1988	a	3.5	3.2	3.2	3.3	0.2	4.0	0.8
1986-1989	a	3.3	3.1	3.1	3.3	0.2	3.8	0.7
1987-1990	a	2.8	2.6	2.6	3.0	0.4	3.4	0.8
1988-1991	a	b	1.6	1.5	2.5	1.0	3.2	1.7
1989-1992	a	b	1.1	1.0	2.3	1.3	3.2	2.2
Statistics for 1976-1989								
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	0.9	n.a.	1.3
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	0.9	n.a.	1.4
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.2	n.a.	1.5

SOURCES: Congressional Budget Office; Office of Management and Budget; Department of Commerce, Bureau of Economic Analysis.

NOTES: Values are for the four-year growth rates for real gross national product (GNP) last reported by the Bureau of Economic Analysis, not the first reported values. Forecast values are for the average growth of real GNP over the four-year period. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate. The benchmark-years-weighted index of actual GNP was used in calculating the errors.

n.a. = not applicable.

a. Data for 1972-dollar GNP are available only through the third quarter of 1985.

b. Data for 1982-dollar GNP are available only through the third quarter of 1991.

Appendix B

Major Contributors to the Revenue and Spending Projections

The following analysts prepared the revenue and spending projections in this report:

Revenue Projections

Mark Booth	Corporate income taxes, Federal Reserve System earnings
Maureen Griffin	Social insurance contributions, excise taxes, estate and gift taxes
Matthew Melillo	Excise taxes, national income and product account receipts
Linda Radey	Excise taxes
Melissa Sampson	Customs duties, miscellaneous receipts
David Weiner	Individual income taxes

Spending Projections

Defense, International Affairs, and Veterans' Affairs

Eugene Bryton	Defense
Elizabeth Chambers	Defense
Kent Christensen	International affairs
Victoria Fraider	Veterans' benefits, defense
Raymond Hall	Defense
William Myers	Defense
Mary Helen Petrus	Veterans' compensation and pensions
Amy Plapp	Defense
Kathleen Shepherd	Veterans' benefits
Lisa Siegel	Defense
Joseph Whitehill	International affairs

Human Resources

Wayne Boyington	Civil Service Retirement, Railroad Retirement
Paul Cullinan	Social Security
Alan Fairbank	Hospital Insurance
Scott Harrison	Medicare
Jean Hearne	Medicaid
Lori Housman	Medicare
Julia Isaacs	Food stamps, foster care, child care
Deborah Kalcevic	Education

Lisa Layman	Medicare
Jeffrey Lemieux	Federal employee health benefits
Cory Oltman	Unemployment insurance, training programs
Pat Purcell	Supplemental Security Income, Medicaid
Dorothy Rosenbaum	Education, social service programs
Connie Takata	Public Health Service
John Tapogna	Aid to Families with Dependent Children, child support enforcement

Natural and Physical Resources

Michael Buhl	General government, Postal Service
Kim Cawley	Energy, pollution control and abatement
Patricia Conroy	Community and regional development, natural resources, general government
Peter Fontaine	Energy, Outer Continental Shelf receipts
Mark Grabowicz	Science and space, justice
Theresa Gullo	Water resources, conservation, land management
James Hearn	General government, deposit insurance
David Hull	Agriculture
Mary Maginniss	Deposit insurance
Eileen Manfredi	Agriculture
Ian McCormick	Agriculture
Susanne Mehlman	Justice, Federal Housing Administration
Marjorie Miller	Transportation
John Patterson	Transportation
Deborah Reis	Recreation, water transportation
Brent Shipp	Housing and mortgage credit
John Webb	Commerce, disaster relief

Other

Janet Airis	Appropriation bills
Edward Blau	Appropriation bills
Karin Carr	Budget projections, historical data
Betty Embrey	Appropriation bills
Kenneth Farris	Computer support
Glen Goodnow	Authorization bills
Alice Grant	Appropriation bills
Leslie Griffin	Budget projections, civilian agency pay
Vernon Hammett	Computer support
Ellen Hays	Other interest, credit programs
Sandra Hoffman	Computer support
Jeffrey Holland	Net interest on the public debt, national income and product accounts
Deborah Keefe	Computer support
Terri Linger	Computer support
Fritz Maier	Computer support
Kathy Ruffing	Treasury borrowing, interest, and debt
Robert Sempsey	Appropriation bills